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Functional outcomes in relation with the progression level in young degenerative disc disease patients

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Abstract

Introduction. The aim of the study was to evaluate the functional outcomes in degenerative disc disease patients by the type of herniation.
Methods. The study covered 48 individuals (28 females and 20 males) aged 18–35 years who were found with a degenerative disc disease in lumbar spine (protrusion or extrusion according to the American Society of Neuroradiology). The participants were divided into two groups by the type of herniation: the protrusion and the extrusion group. The functional outcome was assessed with the Oswestry Disability Index (ODI) questionnaire and the Numeric Rating Scale (NRS).
Results. Statistically significant differences were shown in ODI scores in both groups. The extrusion group demonstrated a 7.6% higher level of functional disability related to lumbar spine pain when compared with the protrusion group. The NRS results were not statistically significant between the groups. A statistically significant difference was observed between the groups during standing position, during sleep and in sex life. Respectively a 27%, 32%, and 28% greater number of individuals in the extrusion group reported problems related to these three daily activities when compared with the protrusion group.
Conclusions. Our study results revealed statistically significant differences in general ODI scores between the groups. Moreover, patients with protruded lumbar disc showed better outcomes in routine activities when compared with the extrusion group.

Key words: low back pain, lumbar disc herniation, protrusion, extrusion, Oswestry Disability Index

Introduction

The prevalence of low back pain indicates a far-reaching and essential problem of the contemporary medicine. Moreover, current scientific research shows that in highly-developed countries the problem is present among nearly 84% of the population [1]. The reasons for the high incidence are bound with extensive risk factors of the pathology: type of work, lack or proper physical activity, or inter-individual intervertebral disc features may have impact on the patient's condition [2]. Nevertheless, the diagnosis is not always clear because of the aetiology of degenerative disc disease (DDD). Research has shown that low back pain can be caused by disorders not directly related to the spine structures and may be primarily associated with the sacroiliac or hip joints, although the same studies indicate that spine structural damage is responsible for almost 65% of lower back pain [3].

It is estimated by some authors that the prevalence of lumbar disc herniation in patients who suffer from low back pain reaches about 90% [4]. According to the American Society of Neuroradiology, there are two stages of lumbar disc herniation: protrusion and extrusion [5]. These vary in nucleus pulposus and annular tear severity stages. Protrusion may be focal or broad-based and refers to the situation when the largest plane of the disc edges is less than the distance between the edges of the base. A disc is extruded when the *annulus fibrosus* is ruptured and inferior material can migrate from the inside to outside of the disc, causing damage to the nerve structures. Both pathologies can produce pain as a result of contact with the longitudinal posterior ligament, nerve roots, or dura mater.

However, despite highly-developed imaging methods, the correlation between radiology imaging and functional or clinical outcomes in DDD patients still remains unclear [6, 7]. Many surgeons have to consider a non-surgical way of treatment; on the one hand, the patient's imaging leaves no doubt about the need of the operation, but on the other, the clinical and functional outcome seems to be at least acceptable, suggesting the possibility to undertake non-surgical treatment, such as physical therapy [8]. Frequently, patients with protruded lumbar disc suffer from pain and feel uncomfortable about their daily activities.

The aim of the study was to evaluate the functional outcome in DDD patients by the type of the herniation. The following research questions were asked:

1. Does functional outcome demonstrate diversity in DDD patients according to the type of herniation?
2. Are there any differences in general pain suffering between the protrusion and extrusion group?
3. Are there any differences in pain suffering during specific activities between patients with protrusion and extrusion?

Subjects and methods

Subjects

This study involved 48 individuals (28 females and 20 males) aged 18–35 years who were found with DDD in lumbar spine. The diagnosis was made by an experienced radiologist on the basis of magnetic resonance imaging (MRI) or computer tomography (CT). The research was carried out in the Department of Orthopaedics and Traumatology in Wroclaw Medical University, Poland. The study was approved by the Scientific Research Ethics Committee at the University School of Physical Education in Wrocław, Poland. All the participants received detailed information on the research, and were informed that they could opt out at any time without incurring any consequences. The inclusion criteria were: age 18–35 years, DDD in lumbar spine confirmed by MRI or CT (protrusion/extrusion according to the American Society of Neuroradiology), subacute state of the disease. The exclusion criteria were: advanced degenerative changes in lumbar facet joints, spondylolisthesis, history of lumbar spine fractures, rheumatic disease, lumbosacral transitional vertebra, neurological deficit in lower extremities. The individuals were divided into two groups by the type of herniation. The first group (PRO) covered 23 subjects with a protruded lumbar disc; their mean age was 26.7 ± 2.9 years. The second group (EXT) included 25 participants with an extruded lumbar disc; their mean age was 29.2 ± 3.3 years. Table 1 shows the differences in the somatic features in both groups.

Functional outcome

To evaluate the functional outcome, the standard Oswestry Disability Index (ODI) questionnaire was used. It contained 10 sections which referred to general pain intensity and pain felt exactly in different aspects of daily activities (personal care, lifting, walking, sitting, sleeping, sex life, social life, travelling). Each section included 6 possible answers (0 points stood for no pain at all, while 5 points equalled maximum pain and being unable to carry out the activity). The maximum number of points was 50 for each participant, and the overall score was presented as percentage. Later, the number of individuals who felt pain in each of the sections separately was determined. It was assumed that the 0-point answer stood for absence of pain, and any other answer referred to the experience of pain during daily activities. The ODI scale is sufficiently wide to reliably detect improvement or worsening in most subjects, and its reliability was defined to excess 80% [9]. To depict the participants' subjective pain perception, the Numeric Rating Scale (NRS) was applied. The NRS is an 11-point visual scale (0–10) by which each individual defined their actual pain intensity; the lower the value, the less intensive pain was reported by the patient. NRS shows adequate responsiveness to be used in both clinical and research settings [10].

Statistical analysis

All computations were performed with the Statistica 12 PL software by StatSoft. The differences in the somatic features between the two groups were validated by Student's t-test. The comparison of ODI and NRS group results were performed with Mann-Whitney U test. Differences in the number of individuals who felt pain during specific daily activities were calculated with the use of the chi^2 test. Statistical significance was established at the level of $p < 0.05$.

Results

Statistically significant differences were shown in ODI scores in both groups. The EXT group demonstrated a 7.6% (p = 0.001) higher level of functional disability related to lumbar spine pain when compared with the PRO group. The NRS results were not statistically significant between the groups (p = 0.15). Table 2 demonstrates the diversity of ODI and NRS scores between the groups.

The analysis of pain during daily activities has shown that in the EXT group, there were more individuals who felt pain over each activity. A statistically significant difference was observed between the groups during standing position, during sleep and in sex life. Respectively a 27%, 32%, and 28% greater number of individuals in the EXT group reported problems related to these three daily activities when compared with the PRO group. Table 3 shows the share of individuals who suffer from pain during specific activities according to the ODI questionnaire.

Discussion

Many authors confirm that disc imaging results do not correlate well with the patients' functional and clinical outcomes [11, 12]. In these studies, a standard 5-point Pfirrmann's clas-

Table 1. Mean values (± *SD*) of somatic features in both study groups

Feature	PRO group	EXT group	*p*-value
Age [years]	26.7 ± 2.9	29.2 ± 3.3	0.009*
Body height [cm]	171 ± 8.7	163 ± 8.7	NS
Body mass [kg]	70.0 ± 15.1	73.7 ± 14.9	NS
Female/male	12/11	16/9	NS

PRO – protrusion, EXT – extrusion, NS – not significant
* $p < 0.05$

Table 2. Oswestry Disability Index (ODI) and Numeric Rating Scale (NRS) results

	ODI					NRS				
	PRO group	EXT group	U	Z	*p*	PRO group	EXT group	U	Z	*p*
$\bar{x}$ ± *SD*	19.9 ± 7.4	27.5 ± 8.7	135.0	–3.13	0.001	5.2 ± 1.1	5.6 ± 2.2	217.5	–1.43	NS

PRO – protrusion, EXT – extrusion, NS – not significant

Table 3. Number of individuals who suffer from pain during specific activities

Pain context	Total [%]			Pain context:	Total [%]		
	PRO	EXT	*p*		PRO	EXT	*p*
General pain	96	100	NS	Standing	57	84	0.03*
Personal care	78	88	NS	Sleeping	48	80	0.02*
Lifting	91	92	NS	Sex life	52	80	0.04*
Walking	74	92	NS	Social life	35	48	NS
Sitting	78	92	NS	Traveling	39	40	NS

PRO – protrusion, EXT – extrusion, NS – not significant
* $p < 0.05$

sification for disc degeneration and Modic changes to describe the vertebra body and end-plate condition were used. The studies were aimed to evaluate the correlation of the MRI and functional (ODI) results. The analysis referred to both the degenerative changes of facet joints and DDD according to Pfirrmann's grade classification. The classification includes 5 radiologically different stages which take into account the condition of the disc, nucleus pulposus, signal intensity, and disc height. This grade scale can be conventionally divided into two main groups according to the last criteria: 1–3 grades include normal disc height, while grades 4 and 5 stand for reduced disc height. Therefore, in order to simplify the relations, a 2-grade (protrusion and extrusion) American Society of Neuroradiology classification was used [13]. Pfirrmann's classification presents higher value with regard to radiological features only. Modic changes refer to the vertebral body end-plate MRI signal (T1: bone marrow oedema and inflammation; T2: presence of yellow fatty marrow as a result of marrow ischaemia; T3: subchondral bony sclerosis). Studies of the aforementioned authors confirm the need to develop contemporary clinical diagnostic tools to properly and efficiently assess and evaluate the functional outcomes of DDD patients.

Our study results showed statistically significant differences in general ODI scores between the groups. Patients from the PRO group showed decreased pain and better outcomes in routine activities when compared with the EXT group. Other studies revealed a tendency to clarify the difference between ODI and Visual Analogue Scale (VAS) scores between the groups (1–3 and 4–5 according to Pfirrmann's classification) in patients aged 50–65 years. This confirms that the subjective functional condition (ODI and VAS) shows differences in older patients as well as in younger age groups [12, 14].

In none of the analysed studies was the explanation of the disease's phase found, which might play an important role in the assessment of the patients' condition. The first analysis of ODI scores concerned the general score, while the further one referred to specific aspects included in the questionnaire. The results show that the larger disc pathologies were observed in patients, the higher values they presented in the ODI questionnaire. This fact indicates that the DDD severity plays an important role in patients' health condition. Higher ODI values were observed in each section in the EXT group as compared with the PRO group, but only 3 of the differences were statistically significant. There were no significant differences in NRS results between the groups. Consequently, inter-individual spinal canal compromise might be important in the explaination. It might affect the course of illness by provoking pain with slight disc damage or, conversely, without causing pain, but with massive disc pathology. This may indicate that there is no one universal scheme for assessing and evaluating functional and clinical outcomes in DDD patients.

Among the analysed ODI aspects, statistically significant differences were observed only with reference to standing (57% vs. 84%), sleeping (48% vs. 80%), and sex life (52% vs. 80%). Sleeping and standing are the only static activities in the entire questionnaire. This finding might be related to poorer nutrition of the disc structure during static positions owing to lack of variable pressure, which is responsible for further degeneration of the disc [15]. Pain and discomfort during sex life reported by patients presented statistically significant differences between the groups. Other authors [14–17] also observed that the more patients suffered in their sex life, the higher ODI and VAS scores they obtained, but according to these studies this dysfunction is caused by psychological disorders rather than physical impairment [18, 19].

Limitation

The article is burdened with limitations which include a small number of individuals, very few clinical tools used for patients' evaluation and their subjectivity, and, what is more, lack of information about the percentage of spinal canal compromise. Low back pain may vary depending on the single day. The validity and reliability of NRS and ODI may be reached by applying 3 pain measurements per day for 4 following days [20]. It is necessary to continue and develop studies in this field with greater numbers of individuals and among other age groups. Additionally, more functional outcome tools and more specific radiological imaging analysis, such as measuring disc material and inter-individual spinal canal dimensions, are needed.

Conclusions

1. Individuals with extruded lumbar disc show worse functional outcomes than those with protruded lumbar disc.
2. There is no difference in general pain suffering between the protrusion and extrusion groups.
3. Patients with extruded lumbar disc suffer significantly more pain during standing, sleeping, and sex activities than those with protruded lumbar disc.

Conflict of interest statement:
Authors state no conflict of interest.

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